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the old numerical values could be dropped. The easiest and least expensive way of introducing the system would probably be to have certain United States government departments adopt the system exclusively after a certain date. Only those persons or firms dealing directly with those departments would then be compelled to change their listings and prices. Gradually, the process would be likely to extend into general literature, business and manufacture, without the exercise of compulsion.

THE METRIC SYSTEM FROM THE PAN-AMERICAN STANDPOINT

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THE Pan-American Union was created by a resolution adopted in the First International Conference of the American republics held in Washington in 1889. All the twenty-one independent republics of North and South America join together in the support and maintenance of the institution which is governed by a board consisting of the secretary of state, *ex officio,* and the diplomatic representatives in Washington of the twenty Latin American republics. Its general purpose is to create and foster a larger commercial and intellectual intercourse between the republics of the American continent. It is an all American institution interested in every question which does or might concern the two Americas, among which the question of weights and measures is not the least important.

If there is one thing in the future that can be predicted as a truth with more certainty than another it is the changing position of the United States in respect to its foreign commerce. This change, while it will be accelerated by the war, is in no way a result thereof. It is due entirely to our own development, consequently creating a changed international commercial status for the United States. It is industrial evolution in its comparative relations.

Formerly our exports were of raw materials, primary food products, slightly wrought commodities, in fact, of those things wherein the larger commercial values were represented by the work of nature and the lesser values by the work of man. We were selling primarily the minerals from our hills, the trees from our forests, and in our cotton and our grain the fertilizing elements of our soils. We were selling for the most part the handiwork of nature and not of man. We were depleting our capital resources—but on the whole not at a loss. We were following the natural highway of evolution from the forest and mining industries to the pastoral, to the agricultural and on to the mechanical. In a sense we were converting a part of our static capital into liquid capital.

In the last decade or two the character of our exports has begun to change. Measured by values, we are selling less of the products of our mines, of our forests and of our fields and more of the products of our labor and skill. Where we sold lumber we are selling chairs, tables and desks, where we sold pig iron we are selling knives, plows and machinery.

It is not necessary to elaborate this idea. It must be apparent to every one that we are coming to the point where our growing population will consume all our own food products, where our mills and factories will use all our own raw materials and where our only surpluses for export will be the finished and highly wrought products of these mills and factories. This is as it should be, for thus we shall be selling for the most what man creates and for the least what nature creates. What has all this to do with the metric system? Much, very much.

Broadly speaking, all exports may be classed under two heads: First, such as sell themselves, that is, where the buying and selling machinery is for the most part put in operation by the buyer, and, second, such as must be sold; that is, where the machinery is operated almost entirely by the seller. These two classes correspond almost exactly with the two other classes first indicated above, viz., raw materials and primary food products, on the one hand, and finished and highly wrought commodities, on the other.

Cotton, wheat, flour, lumber, unwrought metals, oils, hides, wool, meat and the like sell themselves. Wherever in the world these things are needed and there is the price to pay, the buyer sets in operation the machinery to secure them. The farmer does not have to send out commercial travelers to sell his cotton. He does not have to advertise it in the papers. He delivers it to the railway and here it is caught up by a machine in no wise of his creation which finally dumps it down at some factory door, where, the farmer never knows; it may be in Massachusetts and it may be in Italy. But for the factory that spins the cotton into yarn and weaves the yarn into cloth it is another matter. This cloth does not sell itself. It must be sold and its maker must find a market for it. The impulse begins at the factory, it follows through the broker, the wholesaler, the retailer down to the ultimate consumer. Cloth, knives, plows and desks must be pushed from behind. They are not pulled from in front as is cotton, wheat and pig iron.

It is here that we come to the point where weights and measures are important. It is a matter of small or even no moment to the foreign purchaser of our wheat and cotton that as produced they were measured in bushels and pounds. These measures are not stamped upon the wheat, cotton, oil, iron, copper and the like. If he wishes to buy 1,000 metric quintals or 1,000 liters of any of these, it is a matter of no interest to him that the producer in the United States measured the product by pounds, bushels or gallons. It is a matter of little interest that on the manifest of the ship that brought him these goods they were denoted by these measures. All this can be changed and is easily changed. Not so if the goods be shoes, cloth, screws, clothing, tools and machinery. Here the inch, the yard and the pound are wrought into the article as a part of its warp and its weft. He can not sell them, his customers will not buy them. What do they know of a 15½ collar or the No. 8 shoe? The shopkeepers can not sell the yard-wide cloth to people who are used to buying meter-wide cloth. The artisan who needs a 2½ centimeter chisel will not take an inch chisel instead. The man who needs a bolt or a nut threaded to the metric scale will not take such as are threaded to the inch scale. Nothing fits, nothing suits, and finally nothing is salable.

Our changing foreign trade demands a change in our customary measures. So long as we cling to our inches, yards, pounds and gallons we carry a weight, a useless weight, that of itself is sufficient to hold us back from that first place as an exporter of highly wrought manufactures which is ours by right of skill, enterprise and resources.

The importance of the metric scale in foreign commerce even now presses hard upon us, and it will press harder and yet harder in the future. We must adopt the metric scale, because nearly all the rest of the world, save England and Russia, has adopted it and this world is the market in which we must buy and sell.

Furthermore, we should adopt it because of its inherent merits, its vast superiority even for domestic use over our present system. I think I may say without fear of successful challenge that, while any intelligent child can learn and carry in his mind the whole metric system in three lessons and any adult can master the same in one hour or less of serious study, no man ever has, and probably no man ever will, master the United States system of weights and measures. Personally I would rather undertake to commit to memory the multiplication table up to the factor of 100 than undertake such a task as this. Take the case of bushels and barrels, measures upon which millions upon millions in values of products are bought and sold; there are scores upon scores of different bushels and hundreds upon hundreds of different barrels customary, standard and legal in use in the United States.

The metric system is simplicity itself. It has many merits in nomenclature in interchangeability from lengths to weight to volumes, but the chief merit to my mind is that it has the same base ratio throughout. Measures should have the same base ratio. That they have not is one of the principal inherent weaknesses of our English system as compared with the metric system. For example, suppose that our system had as its base 12—12 inches to the foot, 12 feet to the yard, 12 yards to the rod, 12 rods to the mile; 12 drams to the ounce, 12 ounces to the pound, 12 pints to the quart, 12 quarts to the bushel and so on; then the superiority of the metric system with its base 10 would not be so apparent. This would be true even though there were no interrelation between inches, drams and pints. The interrelation in the metric system between meters, liters and grams is purely artificial. Its value is principally in the determination of the standards and not in their use. The important thing is the identity in base ratios. Were it not that we are not at the beginning of things, 12 would be a much better ratio than 10, because of the many aliquot factors in 12—2, 3, 4, 6. But neither 12, nor any other number than 10, can be made the base ratio, because measures of weights, lengths and capacities are bound up in the larger subject of numbers. Our system of numerical notation is based upon the ratio of 10. It might have been based upon 12 and would in all probability have been the better therefore, but it was not, and so our system of measures must likewise be based on 10. All the world counts by tens and most of the world measures its money by tens. Compare our money values, ten cents a dime, ten dimes a dollar, with English money having no constant ratio, four farthings a penny, twelve pence a shilling, twenty shillings a pound, not to mention five and twenty-one as the ratios of crowns and guineas, and one immediately sees the great advantage of ours over the English system. The child has to learn only one thing, viz., the progression of values, the ratio is constant. He is not in any danger of making the mistake often made by the English child of getting his twelves and his twenties mixed. But the real difficulty comes when the English child begins to put his values down on paper, when he begins to add, subtract, multiply and divide English money values. This difficulty lasts him through life. How many Americans off-hand can give the correct answer in pounds, shillings and pence to the simple problem of 100 units at 7½d. per unit? (£3 2s. 6d.) Yet every American can answer immediately the problem in dollars and cents of 100 units at 7½ cents.

One must be a little on the outside in order to get the right view. The facility with which the Englishman handles his twelves and his twenties does not detract from our wonder that he is able to do it, nor change our judgment that this facility represents an enormous waste of effort. So to the Frenchman or German our apparent ease in handling twos, fours, twelves, sixteens and thirty-twos, in pints, quarts, inches, ounces and bushels is a subject of wonder, but not of envy.

A mile has 8 furlongs, a furlong 40 rods, a rod 2¾ fathoms, a fathom 2 yards, a yard 3 feet, a foot 12 inches and an inch 3 barley corns. A ton has 20 cwt., a hundred weight has 100 lbs.—unless it be a long ton and then it has 112 lbs.—a pound has 16 ounces—unless it be a troy pound—an ounce has 16 drams and a dram has $27\frac{11}{32}$ grains. This is all as wonderful as a cubist painting.

Nevertheless, we can be of good cheer. There is worse to come. A Frenchman, a German or a Brazilian has one quart—he calls it a liter and it is the same in France, in Germany and in Brazil. We have two quarts, the wet and the dry. One of them is smaller than the liter and the other is larger. Our housewives must measure their molasses and vinegar in the one and their flour and beans in the other, otherwise the domestic economy goes all awry.

Pints, quarts, gallons and bushels are an inheritance from Great Britain, the British wine gallon being the basis of our wet measures and the Winchester bushel of our dry. But the British have discarded both, and adopted a new and larger standard gallon and bushel. So 50 gallons doesn't seem to mean much of anything unless one knows whether it is whiskey or walnuts, American or English. But the term bushel is used commercially in two senses, as a measure of volume and as a conventional weight. The two are supposed to be interchangeable and are so considered, but they are not. The farmer measures his grain by volume, the buyer by weight. The volume bushel is standard, the same in every state, but the weight bushel, the bushel of larger commerce, is not. Wheat is 60 lbs. everywhere. Rye is 56 lbs. in most states, but is 54 in California and 50 in Maine. Barley is 48 lbs. in the larger number of states, but is 45 in Arizona, 46 in Oregon, 47 in Pennsylvania, Kentucky, Georgia and Alabama, and is 50 in California. Buckwheat is 40 lbs. in California, 42 in N. Dakota, S. Dakota, Oregon and Washington, 48 in nine states, 50 in seven, 52 in eleven and 56 in Kentucky. Shelled corn may be anywhere from 50 to 58 lbs. and corn in the ear may vary by law according to the month in which it is weighed. One of the most familiar units of commercial measure is the barrel. Apples, potatoes, vegetables generally, flour, lime, crude oil, cement and dozens of other commodities are customarily bought and sold by the barrel. For farm produce the measure is ordinarily one of volume, for flour, lime, etc., it is of weight based on volume. It is important to know what is the size of the base barrel. There is no such thing. A bushel by size is standard, but there is no standard barrel or rather there are hundreds of standards. The result is that we have all the difficulties of the bushel multiplied scores of times over.

One could pursue this vein through many channels and everywhere the same condition is met, confusion and uncertainty, entailing commercial loss and inefficiency. Applied to foreign commerce the whole mass of incongruities known as the American system of weights and measures is impossible. But we are told that we can not change it, that it is too firmly fixed. I doubt this.

There are certain manufacturing industries whose tool equipment, upon the inch and foot gauge, can not be adjusted to the meter gauge, but these are very few. Most tools can be adjusted at but little cost.

For the rest the change here would be easy as it has proved easy in every country which has adopted the metric system. This statement is sometimes denied. The denial, however, is based upon a confusion of ideas. It has been found somewhat difficult in countries adopting the metric scale to do away with the names of the most used measures, such as yards, quarts, pounds, miles, etc., or rather of the equivalents of these English words in the language of the country adopting the new system. Pound, libra, livre, pfund, etc., was an almost universal measure. Not always the same, of course, but in most cases very nearly the same. Now in substituting kilogram for pound, it has been found that people were slow to substitute the new word. Take all the various pounds of France, the German states (all different), Austria, Hungary, Scandinavia, Italy, Spain, etc., in general the kilogram was two pounds or a little over. What happened? The people kept the word, but applied it to a half kilogram, 500 grams. So we have at present the pfund in Germany, which is not at all the old Hanoverian, Saxon or Bavarian pfund, but is 500 grams. So likewise we have the libra in many Latin American countries, but it is not the old Spanish libra; it is, as in Germany, the half kilo.

It has been found very easy to substitute the thing, although sometimes difficult to substitute the word. It is the thing that we who advocate the metric system desire, the word is of less importance. It matters but little if having the meter we continue to use the word yard. The important thing is that it be of meter length and divided decimally. I can remember in my childhood that people spoke of shillings and pence—ninepence, two and threepence, shilling, fourpence halfpenny. Strangers might have thought that a hundred years after the adoption of the dollar standard folks in Virginia were yet using English money to count with. Nothing of the kind. The words were an English inheritance, but the thing itself was of pure American invention, and its basis was a dollar divided in six parts—eight in New York. Two and threepence was 37½ cents and fourpence halfpenny was 6¼ cents. These values were approximately two thirds of English values and in New York but little over one half.

Scarcely a vestige of the old standard is left in any country that has adopted the metric system. Now and then in Latin American countries one will hear the old words, but almost always with a meaning adapted to the new scale. Sometimes apparently the old measure is kept. Thus, in Chile in the nitrate industry apparently they keep the old Spanish quintal, 100 Spanish pounds, a little over 101 lbs. avoirdupois. This seemed curious to me, the more so since all Chilean statistical reports give weights of nitrate in the metric scale. When I was last in northern Chile I enquired into this and found that there was not a weighing machine in all the nitrate fields graduated to the old Spanish scale. They used the metric scale, but they measured 46 kilograms to the quintal, and 46 kilograms is not exactly the old quintal.

That we must, and furthermore that we shall, come to the metric system is to my mind beyond question. First, because the exigencies of our foreign trade make it impossible for us to do otherwise, and second, because the present system is too cumbersome, too uncertain, too complicated and too difficult to learn even for our domestic uses. At the present time one may discern evidences of senility and breaking down in the constant and increasing multiplication of standards. Almost every fruit and vegetable now has its own container and these containers are becoming the customary and in many cases the legal standard of measure in purchase and sale.

We can not help ourselves in the foreign trade, for there we must come to the metric system. It is, of course, quite possible to have two systems, such as, in fact, exist in England to-day, and even in this country, although in a lesser degree. English manufacturers engaged in foreign trade work almost exclusively in the metric scale. In some cases English factories work in two scales, one for the foreign and one for the domestic trade. In the United States we are coming to the same condition.

The United States, Great Britain and Russia are almost the only countries now outside the fold of the metric system. Russia is only nominally outside, for nearly all Russian mechanical industry and the overwhelming proportion of its foreign trade is unchangeably based on the metric system. Prior to the war Great Britain had for practical purposes adopted the metric system in manufactures for foreign trade. Since the war the metric system has extended into other fields of commerce even into the domestic trade. In the United States the progress has been less rapid, but our factories have turned out enormous supplies of war material manufactured to the metric scale, and to-day thousands upon thousands of our workmen are as familiar with centimeters and grams as they were formerly familiar with inches and ounces.

THE METRIC SYSTEM IN EVERY-DAY LIFE

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THERE seems but little that I can add to the admirable addresses delivered by the distinguished men who have just presented their views. In fact, all I can do is to present a simple story of my own experiences with that beautiful, logical and simple system of weights and measures now used by 437,000,000 of the people of this globe.